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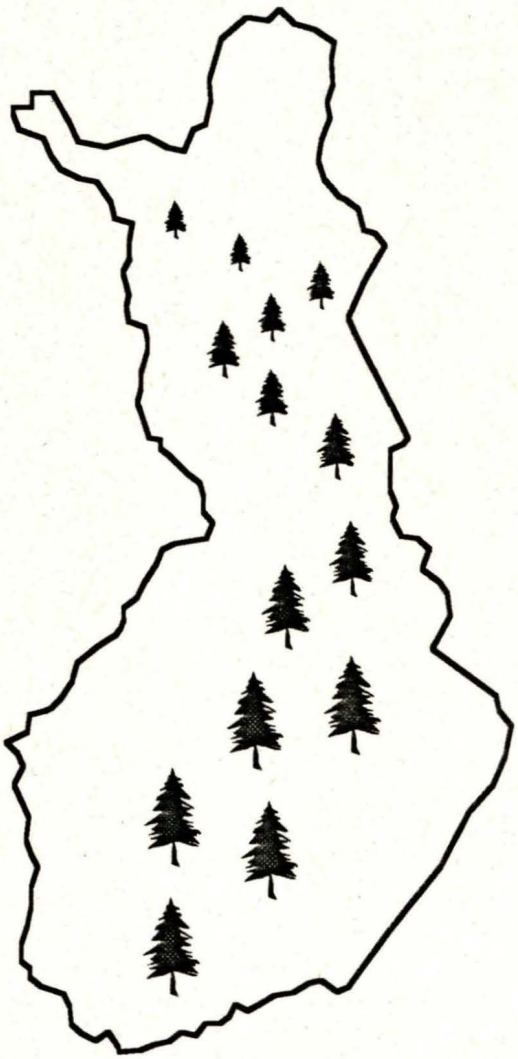
FINLAND TECHNOLOGY EXCHANGE



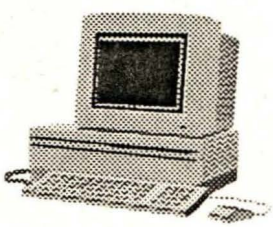
USDA Forest Service

Forest Pest Management

and

Finnish Forest Research

Institute



June 21 - July 6, 1994

Final Report for 28-C4-809 Pd: Hannu Saarenmaa

US/Finland/Russia Technology Exchange Visit
General Information

Title of Exchange:

Evaluation and transfer of technologies related to forest health management

Dates of Exchange:

June 21 - July 6, 1994

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Exchange Background

The U.S. Forest Service, in cooperation with the U.S. Environmental Protection Agency and the National Association of State Foresters, began a national forest health monitoring program in the United States in 1990. The United States program includes detection, evaluation, and intensive site ecosystem monitoring on a permanent plot system. In addition, off-plot monitoring and evaluation is used to enhance plot data.

In support of the United States forest health monitoring program, the Forest Pest Management, Methods Application Group has been evaluating various remote sensing tools for use in this program. Aerial videography is one tool which has shown promise in this arena because it provides for the rapid turnaround time required and can be used under less than ideal weather conditions.

The Technical Research Center of Finland and Karelsilva Oy have recently developed a Super-VHS color infrared video camera which may provide highly useful remotely sensed data for monitoring forest health.

Surveys for detection of pest outbreaks in Russian forests need to be improved. Because of the vast areas involved, remote sensing techniques (satellites, aerial photography, and airborne videography) appear to offer the most promise. Much of the technology in use in western countries has been unavailable to Russian forest and pest managers. The proposed technology transfer would include training in remote sensing data acquisition and interpretation to Russian and Finnish Forest Pest managers.

Immediate Objectives

An immediate objective of this exchange was to open a dialogue and develop cooperative relationships which will encourage the flow of remote sensing technology and knowledge between the US, Finland, and Russia for the purpose of monitoring forest health. This exchange was to open additional avenues for the direct exchange of remote sensing technology between individuals and technology centers in Finland and Russia and counterpart individuals and centers of expertise in the United States. Specifically, this effort focused on the transfer of airborne video technology which has recently been developed and applied to forest health monitoring problems in the United States.

In addition, U.S. scientists pursued the desirability of and evaluated the local arrangements for a technology exchange symposium under the banner of Resource Technology 98 - Finland - An International Symposium on Advance Technology in Natural Resource Management.

Long Term Objectives

Organizers of this visit planned to assist the Federal Forest Service of Russia to produce a comprehensive assessment of the forest resources of the Kola Peninsula to: 1) identify major trends in forests affected by air pollution, 2) assist in forecasting expected consequences to develop appropriate new forestry-related policies, and 3) to apply new technologies in implementing ecosystem management.

Activities

Finland and their forestry in brief

Finland covers an area of 134 million acres which is about 1/3 larger than the state of Minnesota. The country shares its borders with Sweden in the west, Norway in the north, Russia in the east and by the Baltic sea in the south and the west. About two-thirds of Finland is forested, of which about 50 million acres are classified as commercial. Finland has nearly 190,000 lakes, most of which are concentrated in the southern half of the country.

Forestry is extremely important in Finland and forest products account for over 50% of the nation's net export earnings. The main tree species in Finland are Scots pine, Norway spruce and two species of birch account for all of the commercial species. Pine account for 45%, spruce 37% and birch about 18% of the growing stock.

Nearly two-thirds of Finnish forests are owned by private owners. These owners supply about 85% of the wood consumed by Finland's forest industry. As early as 1928, Finland realized that private land forestry was extremely important and passed the Private Forestry Act which ensured the sufficiency of timber for the future. The extension forestry program for private owners is unique. Forestry boards supervise and guide private forestry and interpretation and adherence to the Private Forestry act. These tasks are performed with the assistance of local forestry associations. The boards are funded through the government's budgeted funds.

There are two main government forestry branches within the Ministry of Agriculture and Forestry. The Forest and Park Service is a state enterprise which administrates government owned land which covers one-fourth of Finland's land area. There are over 3,000 employees of the Forest and Park service. The starting salary for a forester is about $24,000 per year, which is very similar to that in USDA-Forest Service. The Finnish Forest Research Institute is the main forest research organization in Finland. We visited one of the eight research stations, in Rovaniemi, which had 26 researchers and a total of about 150 people at the research center.

Field Trip Synopis

Pallas-ounastunturi National Park - On June 28th we traveled about 3 hrs north of Rovaniemi to visit the Pallas National Park which is approximately 69 degrees North latitude, about the northern border for the timberline in Finland. Because of the short growing season and climatic factors, all of the stands in this area were park-like with little understory vegetation except for lichens and moss. The climatic factors also appeared to be the major cause of the tree health problems, some of which include wind damage, ice and snow breakage of branches and trunks, winter drying and frost to name a few. The area was primarily composed of Scots pine, Norway spruce and two birch species, mountain and silver birch.

Disease Problems - The most prevalent disease problem was Gremmeniella abietina or scleroderris canker on the Scots pine. It was found just about everywhere we stopped. Apparently, the short and cooler summers are favorable for the disease. We also saw a lot of snow blight damage on Scots pine caused by Phacidium infestans. Snow blight is also serious on Norway spruce too, but it is caused by Lophophacidium hyperboreum. Among the foliage diseases of importance are Lophodermella sulcigena on Scots pine and Lirula macrospora on Norway spruce. Rusts of the genus Coleosporium (Scots pine) and Chrysomya (Norway spruce) have also been known to cause problems in this area.

Insect Problems - The most important insect problem in this area is a birch looper Epirrita autumnata which defoliates mountain birch. In the mid-1960's it defoliated about 1.2 million acres causing a lot of tree mortality and turned many of these areas to tundra. The birch in this area is mixed with Scots pine and Norway spruce, however, so birch defoliation does not appear as severe from the ground or air as, for instance, our defoliation caused by the gypsy moth and forest tent caterpillars. The other important defoliators are the European pine sawfly (Neodiprion sertifer) and the pine sawfly (Diprion pini), both of which feed on Scots pine. There are two shoot beetles (Tomicus piniperda and T. minor) and the spruce bark beetle (Ips typographus) which are important species in Finnish Lapland. We saw quite a bit of shoot damage by T. piniperda, but it did not look like it caused much damage to the tree. Some of the trees, however, were flat topped because of the Tomicus attacks. Tomicus was still overwintering in the bark at the base of the Scots pine when we visited Pallus.

Animal Damage - Reindeer and moose also caused damage by browsing and trampling. The most severe damage appears to be by moose from browsing in the winter when grass and forbs are not available. In Lapland, state compensation for moose damage to forest owners has been over $60,000 annually. Reindeer, however, appear to be having an impact on lichens and ground vegetation because of their high numbers. Foresters said you can tell the browsed areas (Finnish Lapland) from unbrowsed areas (adjacent Russia) on satellite photos.

Field trip to Salla area in Eastern Lapland - On June 30th, we visited eastern Lapland, about a three hour drive from Rovaniemi and only a few miles from the Russian border. This area has been the center of attention because large areas of tree decline (Scots pine) and mortality were noticed by foresters. It was first thought that the decline was caused by huge sulphur emissions near the Finnish border in the Soviet Kola Peninsula. The nearest nickel smelter in Montshegorsh was about 100 miles away and emitted more sulphur than all the industries in Finland. On a detailed examination, however, the damage was found to be caused by Gremmeniella abietina. Examination of the frequency of cankers showed a peak infestation period between 1982-85 when climatic conditions were apparently favorable for infection by the fungus.

Kola Peninsula project - We observed one of the forest health monitoring plots in the Salla area. The plots were installed throughout Lapland and the Kola Peninsula of Russia. It basically measured about the same parameters as our forest health monitoring plots. It also measured sulphur deposition, rainfall, temperature (air and soil) and various tree parameters. It was interesting to note that John Witter from the University of Michigan had visited with people on the project and had advised them on plot design and techniques. John has several projects in the Lake States which incorporate a similar design to the Finnish/Kola monitoring plots. Results from the project have shown that Finnish Lapland has not been impacted by the Russian sulphur emissions.

Nursery tour - There are about 40 nurseries in Finland which produce 180 million seedlings per year, of which 80% are container growth. Twenty-two percent of the total is grown in the four Forest and Park Service nurseries. The nursery visited near Rovaniemi produced 12 million containerized seedlings a year. Scots pine accounted for 70%, Norway spruce 29%, and all others (Siberian larch, silver birch, lodgepole pine, and black spruce) accounted for less than 1% of the tree species growth. Three-fourths of the trees were for state forests and one-quarter for private forest land reforestation.

The pest problems in their nurseries were scleroderris, snow blight and sucking insects. The main pesticides used were the fungicides propiconazole (Tilt), chlorothalonil (Bravo), and the insecticide dimethoate. They alternated treatments of Tilt and Bravo every 3 weeks and only used dimethoate as needed.

The Rovaniemi nursery was very modern and automated. They had an overhead irrigation system which also was used for applications of fertilizer and any pesticide treatments. They appeared to have very few production or health problems with their trees. The cost of producing seedling was about 10 cents apiece, which is very economical for a nursery in an extreme northern climate.

Relevant Literature

Jalkanen, R. et al. 1992 Forest pathological research in northern forests with a special reference to abiotic stress factors. Finnish Forest Institute research p. 451

Anon. 1992? Forestry in Finland Finnish Forestry Assoc. 15 p.

Anon 1992 public relations in the forestry and forest industry sector. Finnish Forestry Assoc. 8 p.

Kartera, J. and R. Jalkanen 1994 the history of shoot damage by Tomicus spp. in a Pinis sylvestris l. stand damaged by the shoot-disease fungus Gremmeniella abietina. J. Appl Entomol. 117, 307-313

Kartera, J. and P. Jalkanen 1992. Disease history of Gremmeniella abietina in a Pinis sylvestris stand. Eur. J. For. Path. 22, 371-378

Accomplishments

Russian Cooperation

The USDA Forest Service supported the travel of Federal Forestry Service of Russian scientist Natalia Malysheva, chief of GIS Department and Alexander Kolokoltcev, Service Research Scientist meet in Rovaniemi, Finland. U.S., Finland and Russian scientists evaluated the U.S. Forest Service's airborne videography system as well as the Finish company, Karelsilva's infrared video camera and optical scanner, AISA. In addition, scientists viewed insect and disease problems common to Finnish Lapland and the Russian Kola Peninsula. Finnish and Russian scientists are currently collaborating to evaluate and monitor emissions from industrial sites in the Kola Peninsula.

Relevant Literature

Malysheva, N. Use of cartographic and aerospace methods for Forest Monitoring in the Baikal Region, All-Russian Scientific Research and Information Centre for Forest Resources, Moscow, Russia

Malysheva, N., Orlova, O., Kolokoltcev, A. The Research on Forest Damage with Airborne Survey in Russia, All-Russian Research and Information Centre for Forest Resources, Moscow, Russia

Decoma, J. (ed) Lapland Forest Damage Project - Russian - Finnish Cooperation Report, Rovaniemi Research Station, The Finnish Forest Research Institute, Rovaniemi, Finland. (A collection of ten papers investigating the effects of emissions from the industrial centers in the Kola Peninsula, Russia)

Rees, W. The Kola Peninsula Project - Preliminary Investigation, Scott Poloc Research Institue, University of Cambridge, Cambridge, UK

Airborne Videography Technology Activities

FPM/MAG shipped a complete airborne (S-VHS, color) image acquisition system to Rovaniemi, Finland. The U.S. system was installed in a Cessna 182 remote sensing aircraft owned and operated by Karelsilva Oy (a Finnish remote sensing company).

During a field trip to the Pallas - Ornastunturin National Park in N.W. Finland ground markers were placed at selected sites for the airborne video mission. The purpose of the field trip was to see a variety of forest pest and forest health conditions. The purpose of the white paper markers was for later use in locating and identifying specific sites representing different levels of defoliation on birch trees on the video imagery.

A video mission was planned and flown over the Pallas test site. The mission consisted of a variety of flight lines with swath widths of 1/8, 1/4, and 1/2 mile ground coverage.

A half-day workshop on videography technology was conducted for the Finnish and Russian participants. The workshop covered a presentation on video image acquisition and image processing techniques, a demonstration of the airborne video system equipment and viewing of the video imagery acquired the day before.

Image processing and analysis activities consisted of digitally grabbing 200 video frames from the video tape and storing them in a computer system for later analysis. A preliminary test of image processing of video data was conducted using supervised and un-supervised processing techniques with ERDAS software. The ability to separate defoliation from non-defoliation shows some promise.

In addition to the activities conducted with the USFS system, flights were made with two Karelsilva remote sensing systems - a color infrared video camera (trademans - SILVACAM) and an airborne imaging spectrometer (tradename - AISA). The SILVACAM video camera's imagery shows promise as a forest health monitoring tool, but due to the limited number of pest problems flown in Finland, it needs additional applications testing. The AISA spectrometer was flown over several test sites, but the full capability of this instrument could not be determined due to computer problems.

Relevant Literature

Braam, B. CIR Video: An Operational Tool for Environmental Monitoring, Karelsilva Oy, Savitaipale, Finland

Braam, B, et. al. Design and First Test Results of the Finnish Airborn Imaging Spectrometer for Different Applications, AISA. Present at SPIE International Symposium, an Optical Engineering and Remote Sensing, Orlando, FL, April 1993

Recommendations

Networking Forestry Information

Forest Pest Management should evaluate the need for computer networking capabilities. After viewing the FFRI's well known forestry Gopher/WWW service and related mailing list for the global forestry community, the U.S. team recommends that MAG and NA personnel team with Regions 2 and 6 to develop a TDP proposal addressing this topic.

IUFRO World Congress

The U.S. Team recommends that FPM send representatives to the 20th IUFRO World Congress August, 1995 in Tempere, Finland. The theme of this World Congress in "Caring for the Forest: Research in a Changing World". Preceding the Congress FFRI, Information Technology Laboratory will present a training session on networking. Patrice Janiga, MAG and Joseph O'Brian, NA, St. Paul, FO would make excellent candidates to take the network training and attend the IUFRO Congress. The information gained and contacts made will be invaluable as this team will be preparing and guiding FPM future activities relative to information networking.

Resource Technology 98 - Finland

Bill White will be recommending to Resource Technology Institute's Board of Directors and International Steering Committee that Resource Technology 98 should be held in Rovaniemi, Finland June or August 1998. Bill will further recommend that the symposium would have a major thrust of information technology under a theme title of "A World of Information". The University of Lapland's Conference Services organization is preparing a bid addressing coordination for a majority of the symposium as well as local and international arrangements.

Continued Russian Federal Forest Service Cooperation

Based on conversations with Natalia Malysheva, Russian Forest Service and Finnish scientists cooperating with Russian scientists on the Lapland Forest Damage Project, U.S. team members believe the following actions to be in the best interest of all involved parties. Invite Natalia Malysheva to the United States in FY 95 to a) review U.S. forest health monitoring activities, b) obtain intensive GIS training and c) prepare a proposal focusing on future activities between the USDA Forest Service and the Federal Forest Service of Russia. The U.S. Team further recommends that future activities with Russia involving the Kola Peninsula should be coordinated and implemented through the Finnish Forestry Research Institute.

The SILVACAM Color Infrared Camera

The SILVACAM color infrared camera appears to have applications as a forest pest detection tool since the video image has a similar appearance as that of color infrared film which has been the most useful film for pest problems. The advantage of video over aerial film is the savings in cost of film and processing, plus fast turnaround time with video. In order to determine the utility of the SILVACAM camera, it needs to be fully evaluated on some of the major pest problems in the U.S.

This could be accomplished through a loan or lease agreement with Karelsilva Oy for a short time period during the summer of 1995. This effort could be combined with a larger remote sensing effort that is being designed to evaluate several future sensor systems under an FPM technology Development Project proposal for FY 95.

Technology exchange team in Finland.

Left to right - Hannu Saarenmaa, Journi Vakeva, Ari Nikula, Bill White, Jim Hanson, Alexander Kolokoltcev, and Natalia Malysheva. Not pictured, Dick Myhre.

MAJOR FOREST HEALTH PROBLEMS VIEWED IN FIELD

Scleroderris canker-caused tree mortality near Finland-Russia

Birch looper larvae and feeding damage.

Reindeer feeding on lichens and forbs in the fragile arctic environment.

Closeup of scleroderris damage on Scots pine

Snow mold dieback on Scots pine

Scleroderris canker caused damage on nursery stock